



2020 Water Quality Report
Fresh Pond Reservation: Class B Ponds, Cambridge, MA
Updated September 14, 2021

The Cambridge Water Department monitors three ponds on the Fresh Pond Reservation: Little Fresh Pond, Black's Nook, and North Pond (figure 1). Water quality samples from each pond are collected quarterly. These shallow ponds have no surface water connections to the Fresh Pond water supply reservoir, and as such, they have negligible influence over water quality in the Cambridge water supply. Gated pipes between Little Fresh Pond and Fresh Pond Reservoir are kept closed under normal operating conditions but are opened as needed in controlled conditions to supply irrigation water to Little Fresh Pond. All three ponds drain the City of Cambridge Municipal Golf Course and the reservation's wooded areas, with overflow connections to the City's storm drain system. Stormwater in the developed areas surrounding the reservation is diverted away to further protect drinking water quality at Fresh Pond Reservoir. Groundwater communication between the ponds, the surrounding developed area, and the reservoir is minimized by keeping the reservoir elevation higher than the water table. This report includes data from the reporting period of April 1, 2020 to March 31, 2021 (reporting year 2020).



Figure 1: Fresh Pond Reservation Waterbodies



Massachusetts Class B waters are designated for fish, other aquatic life and wildlife habitat, and for primary and secondary contact recreation. Class B water quality standards include numeric and narrative standards for dissolved oxygen, temperature, pH, bacteria, solids, color and turbidity, oil and grease, and taste and odor. In this study period, four dry-weather water quality sampling events were conducted. Samples were taken at the surface of each pond using extended poles or hand-grabbing samples after wading in from the shoreline. *In-situ* parameters were measured with a calibrated multi-probe concurrently with grab samples.

2020 Results

Black's Nook- Listed in the 2016 Massachusetts Integrated List of Waters as a Category 5 impaired water for transparency/clarity, nutrient/eutrophication biological indicators, and non-native aquatic plants. Median and average Carlson's trophic state index (TSI) numbers during reporting year 2020 were in the eutrophic range, although the chlorophyll-*a* (chl-*a*) result from the 6/18/2020 sample corresponded to a TSI in the mesotrophic range (figure 2). This indicates that productivity was high at Blacks Nook, a finding supported by an overgrowth of plants in the pond (photograph A).

1. Dissolved Oxygen (DO)

- Of the four surface DO measurements collected during the reporting period, one fell below the Class B standard (≥ 5 mg/L). Respiration from microbial organic matter decomposition and algae and plant growth likely contributed to the low DO concentration during the 8/12/2020 summer sampling event.

Date Below Class B Standard	Time	Result
8/12/20	11:05 AM	2.76 mg/L

2. Temperature

- No violations associated with warm-water fisheries were observed. The Class B standard requires temperatures not to exceed 28.3°C.

3. pH

- No violations observed in samples where pH was measured in the lab; $6.5 < \text{pH} < 8.3$.
- One pH violation was observed from the *in-situ* probe measurements. On 8/12/2020, according to the probe field data, pH was slightly lower than 6.5 at 6.45.

Date Below Class B Standard	Time	Result	Measurement Type
8/12/20	11:05 AM	6.45	Field



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4. Bacteria

- No violations observed. All *E. coli* samples were less than the Class B single sample water quality standard (< 235 colonies/100mL or most probable number (MPN)/ 100 mL for a single sample).

5. Solids

- There are no numeric criteria for solids, but visual observations suggest that neither floating nor suspended solids were an impairment for Black's Nook. However, dense aquatic plant growth limited the potential for swimming and boating (photograph A).

6. Color and Turbidity

- There are no numeric criteria for color and turbidity. However, the standard dictates that water bodies must be free from aesthetically objectionable conditions. CWD observed visibly turbid water during the 8/12/2020 sampling event (photograph A). Measured turbidity at Blacks Nook was also the highest of the reporting year on 8/12/2020 at 9.4 NTU (Table 1).

7. Taste and Odor

- No objectionable odors observed.

8. Oil and Grease

- No samples taken, but no visible oil and grease sheens observed.

Little Fresh Pond (LFP)- Not assessed as part of the 2016 Massachusetts Integrated List of Waters survey. TSI values calculated from chl-*a* results ranged from oligotrophic in January (1/20/2021) to eutrophic in June (6/18/2020) (figure 2). The mean and median TSI placed LFP in the mesotrophic zone (figure 2). These results indicate that LFP is a moderately productive pond, with higher levels of productivity during the growing seasons. Shoreline restoration, vegetated buffers, and a pretreatment swale and forebay system were completed in 2008. Specific conductance readings and sodium and chloride concentrations are consistently among the highest of the reservation ponds (table 1). The values for these parameters closely mirror those of Fresh Pond Reservoir, reflecting the hydrological connectivity via pipes and groundwater communication.

1. Dissolved Oxygen (DO)

- All four DO measurements were above the Class B 5 mg/L DO minimum criterion.



2. Temperature

- No violations associated with warm-water fisheries were observed. The Class B standard requires temperatures not to exceed 28.3 °C.

3. pH

- One violation was observed in August where the pH measurement in the lab exceeded 8.3. However, the field pH measurement from the same event, while on the higher end of typical pH values for the site (8.03), was within the acceptable Class B pH range ($6.5 < \text{pH} < 8.3$) (table 1). Elevated pH could be a sign of algae productivity.

Exceedance Date	Time	Result	Measurement Type
8/12/20	11:05 AM	8.47	Lab

- In January, the *in-situ* pH measured by the water quality probe read 8.61 (above the Class B upper bound) while the pH of the water quality sample analyzed in the lab was only 7.94, within the Class B acceptable range. To collect the measurement and sample, CWD had to break through ice. The ice layer may have prevented atmospheric carbon dioxide from mixing with the pond water, thereby elevating the water pH. The lab pH reading was likely lower due to mixing with atmospheric carbon dioxide.

Exceedance Date	Time	Result	Measurement Type
1/20/21	10:51 AM	8.61	Field

4. Bacteria

- No violations observed. All *E. coli* samples were less than the Class B single sample water quality standard (< 235 colonies/100mL or most probable number (MPN)/ 100 mL for a single sample).

5. Solids

- There are no numeric criteria for solids, but visual observations suggest that neither floating nor suspended solids were an impairment for LFP. However, aquatic plant growth may limit the potential for swimming and boating.



6. Color and Turbidity

- There are no numeric criteria for color and turbidity. However, the standard dictates water bodies must be free from aesthetically objectionable conditions. Aside from aquatic plant growth, CWD did not observe objectionable color or turbidity issues in the 2020 reporting year.

7. Taste and Odor

- No objectionable odors observed.

8. Oil and Grease

- No samples taken, but no visible oil and grease sheens observed.

North Pond- Not assessed as part of the 2016 Massachusetts Integrated List of Waters survey. During the growing season, this pond fills with floating and rooted aquatic plants. All four chl-*a* results from the 2020 reporting year were consistent with a Carlson's TSI for a highly-productive, hypereutrophic pond (figure 2). The hypereutrophic status held even during the January sampling event, a time of year when productivity is typically low. North Pond had the highest average and median TSI readings in the reporting period and was the most eutrophic of the three ponds (figure 2).

1. Dissolved Oxygen (DO)

- All four DO measurements collected during the 2020 reporting year were less than the 5 mg/L Class B minimum allowable concentration. Respiration of algae and plants could account for the low DO. Although low DO is less common in winter since cold water can hold more DO than warm water and microbial respiration tends to slow down, the low DO could reflect the high organic matter load and microbial respiration during decomposition. CWD also broke through a thin layer of ice to collect the January 2021 sample. The ice may have restricted oxygen from the atmosphere from mixing with the water.

Date Below Class B Standard	Time	Result
6/18/2020	10:37 AM	2.38 mg/L
8/12/2020	10:51 AM	1.98 mg/L
12/3/2020	11:32 AM	4.06 mg/L
1/21/2021	11:25 AM	1.48 mg/L



2. Temperature

- No violations associated with warm-water fisheries were observed; temperature remained below 28.3 degrees C.

3. pH

- No violations observed; all laboratory and field pH readings $6.5 < \text{pH} < 8.3$.

4. Bacteria

- No violations observed. All *E. coli* samples were less than the Class B single sample water quality standard (< 235 colonies/100mL or most probable number (MPN)/ 100 mL for a single sample).

5. Solids

- There are no numeric standards for solids. Visual observations suggested that mats of floating or suspended organic matter were a source of impairment for the pond that would discourage swimming and boating and created aesthetically objectionable conditions. The solids were especially problematic during the growing season (photographs C and D).

6. Color and Turbidity

- The hypereutrophic state and water turbidity discourage swimming and boating; during the summer, North Pond becomes choked with aquatic vegetation and suspended organic matter impairing the water for those uses (photographs C and D). Measured turbidity was highest during the 8/12/2020 sampling event (164 NTU), a result that exceeded all other turbidity readings at all sites by an order of magnitude (table 1).

7. Taste and Odor

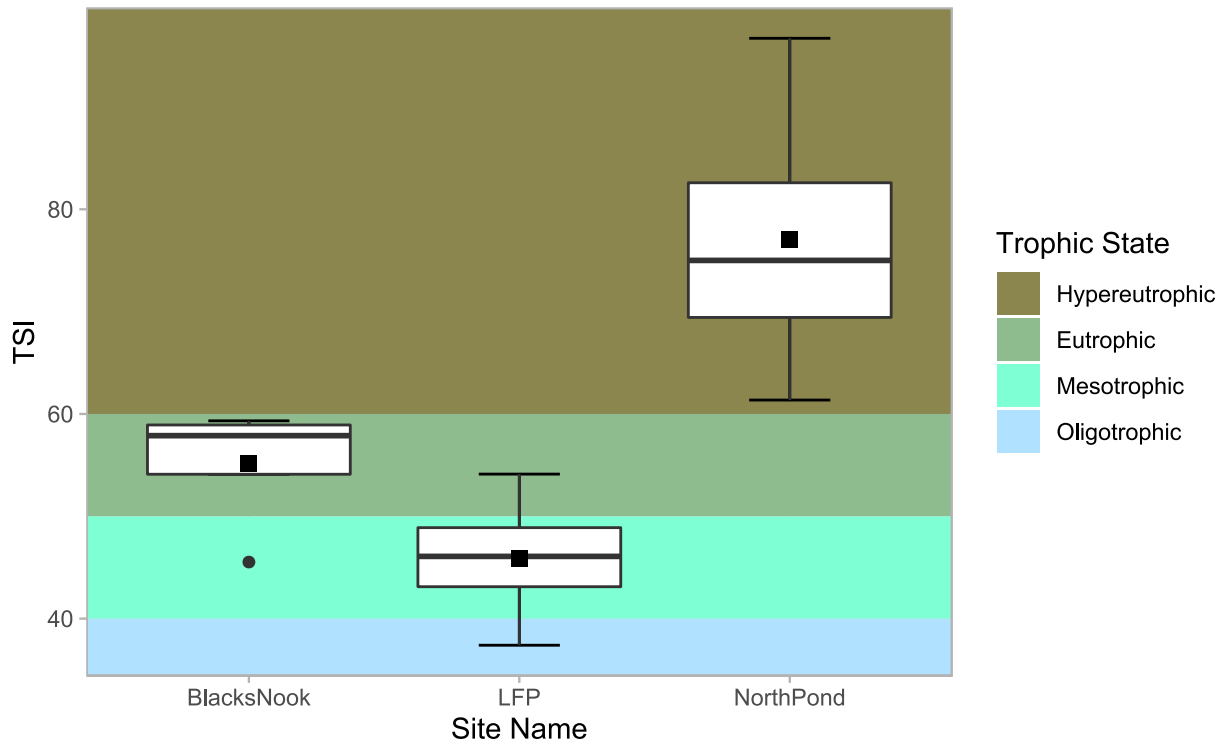
- No objectionable odors observed.

8. Oil and Grease

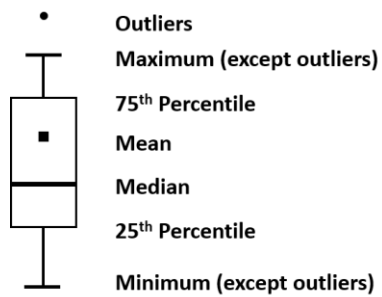
- No samples taken, but no visible sheens observed.



Figure 2: Reservation Pond Trophic State Index from Chlorophyll-*a*, April 1, 2020 – March 31, 2021



Boxplot key:

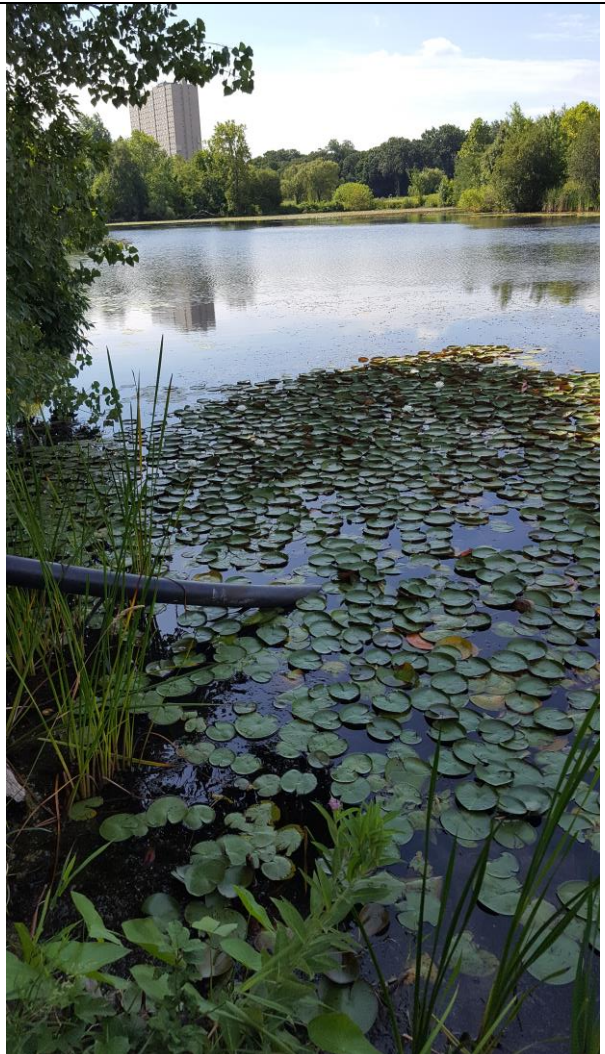




Photograph A: Blacks Nook, view looking northwest, showing dense macrophyte growth and turbidity, on 8/12/2020.



Photograph B: Little Fresh Pond (LFP) looking southwest, 8/12/2020. Dense macrophyte growth is present around the edges of the pond, with submergent plants and open water in the center of the pond.





Photograph C: North Pond, view looking southeast, showing dense macrophyte growth, turbidity, and suspended solids on 6/18/2020.





Photograph D: North Pond, view looking southeast, showing dense macrophyte growth, turbidity, and suspended solids on 8/12/2020.





2020 Fresh Pond Reservation Class B Waters

Table 1: Water Quality Results

Date	Site	Total Alkalinity (mg CaCO ₃ /L)	Al (mg/L)	Ca (mg/L)	Cl (mg/L)	Chl- <i>a</i> (mg/m ³)	Color (CU)	HDO (mg/L)	<i>E. coli</i> (MPN/100 mL)	Fe (mg/L)	Lab pH	<i>In situ</i> probe pH	Mn (mg/L)	Na (mg/L)
6/18/2020	Blacks Nook	47.5	0.03	14.9	11.9	4.58	22	5.98	45	0.43	7.13	6.80	0.084	7
6/18/2020	LFP	55	0.04	27.6	146	11	56	9.04	154	1.3	7.77	7.46	0.214	92
6/18/2020	North Pond	116	2.69	49.8	20.1	124	67	2.38	18	14.6	7.44	6.76	1.97	14
8/12/2020	Blacks Nook	50	0.03	16	13.3	18.7	62	2.76	179	1.85	6.96	6.45	0.349	8
8/12/2020	LFP	56	0.001	27.9	184	4.35	19	7.78	32	0.40	8.47	8.03	0.02	106
8/12/2020	North Pond	125	2.69	70.9	28.3	845	230	1.98	141	21.4	7.36	6.61	2.24	17
12/3/2020	Blacks Nook	66.5	0.04	17.4	22.3	17.7	26	8.75	20	0.54	7.19	7.53	0.046	11
12/3/2020	LFP	54.5	0.07	23.3	139	5.4	27	11.47	20	0.41	7.55	7.9	0.006	79
12/3/2020	North Pond	102	0.056	32.6	30.1	23	102	4.06	91	2.24	7.08	7.25	0.600	15
1/20/2021	Blacks Nook	52	0.03	15.6	21.2	14.7	34	8.27	31	0.73	7.88	7.62	0.061	10
1/20/2021	LFP	47	0.02	22.9	132	<2	18	14.41	<1	0.44	7.94	8.61	0.008	80
1/20/2021	North Pond	101	0.17	34.3	26.7	68.9	161	1.48	13	5.83	6.76	7.41	1.50	13



2020 Fresh Pond Reservation Class B Waters

Table 1: Water Quality Results cont.

Date	Site	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	Lab SpC (uS/cm)	<i>In situ</i> probe SpC (uS/cm)	Total Dissolved Solids (mg/L)	Water Temperature (degrees C)	TKN (mg/L)	Total Organic Carbon (mg/L)	Total Phosphorus (mg/L)	Turbidity (NTU)
6/18/2020	Blacks Nook	0.129	0.053	126	128.5	82.2	23.21	0.568	5	0.0414	1.84
6/18/2020	LFP	0.143	< 0.05	585	600.1	384	24.06	0.887	4.6	0.0595	6.86
6/18/2020	North Pond	0.447	< 0.05	281	412.7	264.1	21.69	3.07	11.9	0.3570	8.18
8/12/2020	Blacks Nook	0.158	0.0702	137	151.7	97.1	25.07	1.2	6.4	0.196	9.4
8/12/2020	LFP	0.133	0.0636	667	721.9	462	27.9	0.554	2.9	0.0319	1.6
8/12/2020	North Pond	1.21	0.0525	308	415.2	265.7	27.23	12	27.8	1.07	164
12/3/2020	Blacks Nook	0.2	< 0.05	170	181.2	115.9	6.31	0.606	5.7	0.0638	3.22
12/3/2020	LFP	0.161	< 0.05	478	582.5	372.8	7.28	0.544	4	0.0276	2.88
12/3/2020	North Pond	0.477	< 0.05	273	302.7	193.7	7.48	1.81	17	0.105	8.35
1/20/2021	Blacks Nook	0.134	< 0.05	148	176.2	112.8	2.63	0.58	5.4	0.0638	3.29
1/20/2021	LFP	0.0763	0.0509	460	563.2	360.4	1.96	0.482	3.3	0.0244	10.6
1/20/2021	North Pond	0.226	< 0.05	254	286.6	183.4	2.61	1.48	14.7	0.173	1.85